EXAMINING THE EFFECTS OF MICROGRAVITY ON PATHOGENICITY AND DRUG RESISTANCE OF *CANDIDA ALBICANS* AND *CANDIDA GLABRATA*.

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Abstract: Small, low-cost, autonomous satellites have created new opportunities for conducting biological experiments in space without relying on the International Space Station. These orbital laboratories have enabled fundamental research in areas related to space biology, to solve key biological obstacles intrinsic to long-duration space flight.

The microgravity environment of space has been shown to alter the expression levels of genes involved in pathogenicity, drug resistance, stress response, and other processes in the opportunistic human fungal pathogen *C. albicans* [1]. Furthermore, long-term exposure to the microgravity environment increases susceptibility to the opportunistic pathogens present in the human gut [2].

C. albicans and *C. glabrata* are normally part of the gut microbiota and account for >90% of all reported cases of Candidiasis [3]. Thus, a better understanding of the response of *C. albicans* and *C. glabrata* to the microgravity environment of space is necessary to improve the quality of human health on long-duration space flights.

In this work, we present the challenges, preliminary results, methods, and the outlook of a project to construct and launch a 3U CubeSat capable of conducting an autonomous microbiology experiment in low Earth orbit using a microfluidics-based system. We developed means of placing *C. albicans* and *C. glabrata* in zero power, long-term stasis such that they remain dormant during pre-launch operations (~5 months). Growth will be reinitiated by injection of growth media upon achieving a stable orbit.

Adhesion and morphogenesis are key virulence determinants in *C. albicans* [4]. To monitor the expression of adhesins and hyphal-specific genes, green fluorescent protein (GFP) is expressed under the promoter of five candidate genes (*ALS1*, *ALS3*, *HWP1*, *INT1*, and *MNT1*). Once on-orbit, on board fluorescence sensors will measure the levels of GFP expression for each virulence gene.

Lastly, the change in drug resistance due to growth in microgravity environment will be assessed by performing minimum inhibitory concentration (MIC) assays using fluconazole and caspofungin, two antifungal agents commonly prescribed in the clinic.

The potential for the normal microbiota to become infectious in space is a major concern for the health of astronauts on a long-duration space flight. A deeper understanding of the real time changes seen in drug resistance, and the virulence gene expression is essential to understanding the effects of microgravity on human health for future space missions.

References:

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